

1 **WHAT IS CLAIMED IS:**

2 1. An irradiation system comprising:

3 a radiation source arranged to emit a radiation beam along at
4 least one beam path extending from the radiation source;
5 an inner shield disposed around the radiation source for
6 attenuating radiation generated by the radiation source, the at
7 least one beam path extending through at least one path
8 aperture in the inner shield;

9 a first conveyor system for transporting articles through the
10 beam path; and an outer shield for attenuating radiation
11 generated by the radiation source disposed around the inner
12 shield and around at least a part of the first conveyor system.

13 2. The irradiation system of claim 1, wherein the irradiation system is
14 arranged into an upper level and a lower level, the first conveyor system
15 and the radiation source being located on the upper level, the irradiation
16 system comprising: a second conveyor system located on the lower level.

17 3. The irradiation system of claim 2, wherein the upper and lower level
18 are separated by a support surface, the at least one beam path including a
19 vertically extending beam path extending through a path aperture in the
20 support surface for irradiating articles conveyed by the second conveyor
21 system.

22 4. The irradiation system of claim 1, wherein the first conveyor system
23 comprises: a process loop disposed around the inner shield.

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1 5. The irradiation system of claim 1, wherein the outer shield forms a
2 first chamber and a second chamber, the first and second chambers being
3 separated by a dividing wall and, the first chamber housing the radiation
4 source.

5 6. The irradiation system of claim 5, wherein the inner shield
6 comprises:

7 a removable inner module for allowing access to the radiation
8 source.

9 7. The irradiation system of claim 6, wherein the outer shield
10 comprises:

11 a removable outer module for allowing access to the radiation
12 source, the removable inner module and the removable outer
13 module being sized so that the radiation source can pass
14 through the inner and outer shield when the removable inner
15 and outer modules are removed.

16 8. The irradiation system of claim 5, comprising:

17 a wall in the second chamber extending substantially parallel
18 to the dividing wall.

19 9. The irradiation system of claim 5, wherein the first conveyor system
20 comprises:

21 a process loop disposed around the inner shield; an entry
22 conveyor system having a first end and a second end, the
23 second end being arranged to convey articles to the process

1 loop; and
2 an exit conveyor system having a first end and a second end,
3 the first end being arranged to convey articles from the
4 process loop, wherein the entry conveyor and the exit
5 conveyor extend through an opening in the dividing wall.

6 10. The irradiation system of claim 9, wherein the exit conveyor system
7 and the entry conveyor system extend through an opening in the outer
8 shield.

9 11. The irradiation system of claim 5, the outer shield comprising:
10 two side walls;
11 a first end wall extending substantially perpendicularly to and
12 connected to the side walls;
13 and a second end wall connected to the side walls, wherein the
14 dividing wall is substantially parallel to the second end wall.

15 12. The irradiation system of claim 11, comprising:
16 a wall in the second chamber extending substantially parallel
17 to the dividing wall.

18 13. The irradiation system of claim 1, wherein the inner shield
19 comprises:

20 a removable inner module for allowing access to the radiation
21 source; and
22 a removable outer module for allowing access to the radiation
23 source, the removable inner module and the removable outer

1 module being sized so that the radiation source can pass
2 through openings left in the inner and outer shields when the
3 removable inner and outer modules are removed.

4 14. The irradiation system of claim 13, comprising:

5 at least one port in the removable outer module for allowing
6 ballast material to pass out of the removable outer module.

7 15. The irradiation system of claim 1, comprising:

8 a ceiling over the upper level comprising a volume of ballast
9 material, a portion of the ballast material covering the outer
10 shield.

11 16. The irradiation system of claim 1, comprising:

12 a ceiling extending over the irradiation system and having at
13 least one removable ceiling plug for allowing access to the
14 radiation source.

15 17. The irradiation system of claim 16, wherein the removable ceiling
16 plug allows for removal of a subassembly of the radiation source from the
17 irradiation system.

18 18. An irradiation system arranged in an upper level and a lower level,
19 comprising:

20 a radiation source in the upper level arranged to emit a
21 radiation beam along a first beam path for irradiating articles
22 on the upper level, and to emit radiation along a third beam
23 path for irradiating articles on the lower level;

09987968-111601

1 an upper level shield disposed around the radiation source for
2 attenuating radiation generated by the radiation source;
3 a first conveyor system for transporting articles through the
4 first beam path; and
5 a second conveyor system for transporting articles through the
6 third beam path.

7 19. The irradiation system of claim 18, where in the third beam path
8 extends generally vertically from the upper level to the lower level.

9 20. The irradiation system of claim 18, where in the upper and lower
10 level are separated by a support surface, the third beam path extending
11 through a path aperture in the support surface.

12 21. The irradiation system of claim 198, wherein the third beam path
13 intersects the second conveyor system at a location below an area
14 surrounded by the upper level shield.

15 22. The irradiation system of claim 21, wherein the lower level includes
16 a first chamber and a second chamber, the location where the third beam
17 path and the second conveyor system intersect being located in the first
18 chamber, and the first chamber being at least substantially covered by the
19 upper level shield.

20 23. The irradiation system of claim 18, wherein the radiation source is
21 arranged to emit a radiation beam along a second beam path for irradiating
22 articles on the upper level.

23 24. A method of removing a radiation source from an irradiation system

1 comprising a radiation source arranged to emit a radiation beam along a
2 beam path, an inner shield disposed around the radiation source for
3 attenuating radiation generated by the radiation source, and an outer shield
4 disposed around the inner shield, the method comprising:

5 disconnecting a removable module of the outer shield from the
6 outer shield; disconnecting a removable module of the inner
7 shield from the inner shield; and removing the radiation
8 source from the irradiation system through openings left by
9 the removable modules.

10 25. The method of claim 24, wherein the step of disconnecting a
11 removable module of the outer shield comprises:

12 disconnecting an outer plate of the removable module of the
13 outer shield from adjacent portions of the outer shield;
14 and disconnecting an inner plate of the removable module of
15 the inner shield from adjacent portions of the outer shield.

16 26. The method of claim 25, wherein the step of disconnecting a
17 removable module of the outer shield comprises:

18 removing ballast material from the removable module of the
19 outer shield.

20 27. The method of claim 26, wherein the step of removing ballast
21 material comprises:

22 opening a port in a bottom portion of the removable module of
23 the outer shield; and

